

SHORT COMMUNICATION

DISTRIBUTION OF SPIDERS ON DIFFERENT TYPES OF INFLORESCENCES IN THE BRAZILIAN PANTANAL

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ABSTRACT. Reproductive stems add complexity to vegetation, thereby increasing the range and quality of microhabitats available for arthropods. In this study, we evaluated whether variation in inflorescence characteristics influenced spider distribution. We compared spider guild structure among inflorescences of three herbaceous plant species, *Melanthera latifolia*, *Conyza bonariensis* and *Eupatorium hecatanthum* (Asteraceae), and between inflorescences of *C. bonariensis* in two different phenological stages, flower buds and opened flowers. Total spider abundance was higher on *M. latifolia*, intermediate on *E. hecatanthum*, and lower on *C. bonariensis*. Ambush spiders were more abundant on *M. latifolia* than on the other plant species, while the abundance of hunting spiders did not differ among plant species. Also, spiders recorded on *M. latifolia* were larger than those on both *E. hecatanthum* and *C. bonariensis*. However, ambush spiders were smallest on *M. latifolia*, while hunting spiders on *E. hecatanthum* were larger than on the other plant species. The number of spiders on inflorescences with flower buds did not differ from those with opened flowers, but ambush spiders on inflorescences with opened flowers were larger than those on inflorescences with flower buds. Our results with different inflorescence types support the hypothesis that differences on microhabitat structure influence distribution of spiders.

Keywords: Flower-dwelling spiders, Asteraceae, habitat structure

Habitat structure can influence the abundance, diversity and size distribution of spiders (Scheidler 1990; Evans 1997), since it is related to prey abundance, availability of refuges from predators and favorable microclimate conditions (Gunnarsson 1996; Halaj et al. 1998). Some studies have shown that the added complexity provided by higher densities of leaves and second order branchlets can result in increased abundances and mean body sizes of some species of plant-dwelling spiders (Hatley & MacMahon 1980; Gunnarsson 1990; Halaj et al. 2000).

Inflorescences attract large numbers of herbivorous and pollinating insects due to the availability of pollen, nectar and edible tissues. The abundance of potential prey on plant reproductive stems can influence the assemblage of spiders that visit inflorescences (e.g., Morse & Fritz 1982; Nentwig 1993). In addition, the presence of inflorescences add another dimension to plant architecture by changing microclimate conditions and availability of refuges from predators. Structural characteristics of inflorescences such as branch size, texture, number and size of leaves and flowers, and the arrangement of the biomass in space vary both among plant species and between inflorescences in distinct phe-

nological stages (opened flowers vs. flower buds) within a plant species. However, few studies have considered the use of flowers by spiders, and patterns of spider distribution on inflorescences of different plant species and/or in distinct phenological stages within the same plant species, are still obscure. In this study, we evaluated differences in the abundance and size distribution of crab spiders and hunting spiders among inflorescences of three plant species, and between reproductive stems in different phenological stages within the same plant species.

This study was carried out in November 2000 at the Miranda–Abobral subregion of the Pantanal do Mato Grosso, Central Brazil (19°34'S;57°00'W). The study area consists of natural forest fragments and gallery forests. These fragments have variable sizes, and are surrounded by seasonally flooded fields. Spiders were sampled from three species of herbaceous plants (Asteraceae), common at the edge of gallery forests on the riverside of Rio Miranda. The plant species sampled differed in several inflorescence characteristics: *Melanthera latifolia* (Gardn.) has a 40cm long inflorescence, with few (7.33 ± 1.53 , mean \pm SD; $n = 10$) yellow flowers, each one with a corolla diameter of 6.5 ± 0.87 cm

Table 1.—Results of one-way ANOVAs and multiple comparisons tests comparing the number and body size of spiders (means \pm standard errors) in different guilds (ambush or hunter) on inflorescences from three species of Asteraceae at the edge of a gallery forest. Similar letters connect means that did not differ (Tukey's HSD, $P > 0.05$).

Spiders	<i>M. latifolia</i>	<i>C. bonariensis</i>	<i>E. hecatanthum</i>	<i>F</i>	<i>P</i>
Number of spiders per inflorescence branch					
Total spiders	11.7 \pm 1.1 ^a	4.7 \pm 3.1 ^b	8.0 \pm 1.7 ^{a,b}	8.073	0.020
Ambushers	9.3 \pm 0.4 ^a	2.0 \pm 0.7 ^b	4.3 \pm 2.0 ^b	13.069	0.007
Hunters	1.3 \pm 1.1	1.7 \pm 1.5	3.7 \pm 0.8	1.792	0.245
Body size of spiders (mm)					
Total spiders	1.26 \pm 0.07 ^a	1.54 \pm 0.15 ^a	3.31 \pm 0.82 ^b	10.705	0.010
Ambushers	1.20 \pm 0.07 ^a	1.62 \pm 0.10 ^b	1.82 \pm 0.12 ^b	12.771	0.007
Hunters	1.87 \pm 0.13 ^a	1.87 \pm 0.13 ^a	4.41 \pm 0.58 ^b	21.081	0.008

($n = 10$); *Conyza bonariensis* (L.) Cronq. has a 48cm long inflorescence, with many (33.0 ± 3.60 ; $n = 10$) white flowers (corolla diameter = 1.30 ± 0.10 cm); *Eupatorium hecatanthum* (DC.) Bak. has an inflorescence 12cm long, purple flowers (corolla diameter = 3.47 ± 0.15 cm) and an intermediate number of flowers per inflorescence (22.67 ± 2.52) compared to the other two species. All plant species occurred together within the patches in the sampling sites. They grew intertwined, so that spiders could move from one species to another without spatial barriers.

Samples were made at three distinct sites (replicates) in the edge of the gallery forest. At each site, we collected 10 mature inflorescences (with opened flowers) from each plant species along a 50m transect. The inflorescences were carefully put in a plastic bag and cut at the stem base. Once in the laboratory, the spiders from each stem were removed, identified to family level, and preserved in 70% ethanol. The spiders were categorized into functional groups based on similarities of foraging behavior. Ambush spiders included only members of the family Thomisidae, whereas hunting spiders included the families Salticidae, Oxyopidae, Clubionidae and Anyphaenidae. Web-building spiders and other categories accounted for only 8.2% of all individuals sampled; they were not analysed according to foraging mode due to small sample sizes, and thus were only included in the analysis of the total number of spiders. The body length between chelicerae and spinnerettes of each individual spider was measured to the nearest 0.1mm. The voucher specimens were deposited in the Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul (ZUFMS).

We compared spider abundance and body size distribution between inflorescences in two phenological stages by collecting stems of *Conyza bonariensis* from the same sampling sites. At each site, we collected 10 young inflorescences which had

only flower buds, and 10 mature inflorescences with opened flowers. We focussed on *C. bonariensis* because individual plants of this species with both types of inflorescence were abundant within each sampling site. Sampling procedures were the same as described above.

We used one-way ANOVA to compare the abundance and mean size of spiders both among the three plant species, and between inflorescences in distinct phenological stages (opened flowers vs. flower buds). We used Tukey's HSD multiple comparisons test following ANOVA to determine differences among plant species. We considered that stems sampled within a site were pseudoreplicates, so the variance associated with them was discarded, resulting in three replicates for each treatment level (see Hurlbert 1984). Our significance level was 0.05. Data were transformed to \log_{10} to obtain normality and homogeneity of variances.

Influence of plant species on spider abundance and body size distribution.—The total number of spiders on inflorescences differed among the three plant species. Spiders were more abundant on *M. latifolia* followed by *E. hecatanthum*, whereas *C. bonariensis* had the lowest number of spiders (Table 1). The distribution of ambush and hunting spiders differed among plant species. Ambush spiders were more common on *M. latifolia* compared to both *C. bonariensis* and *E. hecatanthum*, whereas the abundance of hunting spiders did not differ among plant species (Table 1).

Prey availability is regarded as one of the main factors that determine spider abundance (Morse & Fritz 1982; Greenstone 1984; Henschell & Lubin 1997). Although we did not estimate the number of potential prey attracted to the inflorescences of the three plant species, *Melanthera latifolia* is probably more visited by insects than both *C. bonariensis* and *E. hecatanthum*, because it has larger flowers. Inflorescences are regarded as an advertising unit, and several studies showed that larger and more

Table 2.—Results of one-way ANOVAs comparing total number of spiders and abundances of ambush and hunting spiders on inflorescences of *Conyza bonariensis* (Asteraceae) in distinct phenological stages (opened flowers vs flower buds).

Spiders	Flower buds	Opened flowers	F	P
Total spiders	7.3 ± 3.2	4.7 ± 3.1	1.085	0.356
Ambushers	4.0 ± 3.0	2.0 ± 1.0	0.781	0.427
Hunters	2.0 ± 1.7	1.7 ± 2.1	0.172	0.700

opened flowers attract more insects (e.g., Bell 1985; Cohen & Shmida 1993; Bernays and Chapman 1994; Dafni et al. 1997). Thus, *M. latifolia* may be more attractive to spiders than the other species.

Mean body size of spiders sampled on inflorescences also differed among plant species. Spiders on *E. hecatanthum* were larger than those on *C. bonariensis* and *M. latifolia* (Table 1). Ambush spiders on *M. latifolia* were significantly smaller than those on *C. bonariensis* and *E. hecatanthum*. However, hunting spiders found on inflorescences of *E. hecatanthum* were larger than those on both *C. bonariensis* and *M. latifolia*, which sheltered similar sized spiders. Although larger insects may be more frequently attracted by large flowers (Dafni et al. 1997) and could potentially attract larger spiders (Nentwig 1993), studies on vegetative branches show that large spiders are more vulnerable to bird predation (Waldorf 1976; Askenmo et al. 1977). Other structural features of the plants such as branch structural complexity may influence the microhabitat choice by larger spiders due to differences in the availability of refuges against predators (Gunarsson 1990, 1996; Halaj et al. 2000). Thus, there is a need for more studies on the distribution of spiders in distinct inflorescence types, since spider groups may respond differently to traits of inflorescences from different plant species.

Influence of phenological stage on spider abundance and size distribution.—The total number of spiders on inflorescences of *C. bonariensis* with flower buds was not significantly different from those with opened flowers ($F_{1,4} = 1.085$; $P = 0.356$). The abundances of ambush and hunting spiders on both inflorescence types were also similar (Table 2). However, these results should be evaluated with caution. Among the plant species studied, the lowest abundance of spiders was recorded on *C. bonariensis*. The low number of spiders observed could obscure differences between inflorescences in distinct phenological stages, since inflorescences of this species were not very attractive for the spiders. Unfortunately, *C. bonariensis* was the only species in the study area with inflorescences in both phenological stages, and it was not possible to test this effect on plant species which sheltered larger numbers of spiders. On the other

hand, spider body size differed between inflorescence types. Mean body size of ambush spiders was larger on inflorescences with opened flowers when compared with those bearing flower buds ($F_{1,4} = 17.826$; $P = 0.013$), but no differences in body size were recorded for hunting spiders ($F_{1,4} = 0.009$; $P = 0.930$). These data suggest that, at least for some spider groups, inflorescences in distinct phenological stages can represent differences in fine-grained qualities of the habitat such as hiding places or prey availability for larger spiders.

Several studies of plant-dwelling spiders on vegetative branches have shown a strong relationship between non-reproductive branch structure and distribution of different spider guilds (Hatley & MacMahon 1980; Scheidler 1990; Uetz et al. 1999; Halaj et al. 2000). Our results suggest that inflorescence structure and architecture also influences spider assemblages, since spiders were more abundant on some types of inflorescence than on others, and mainly because inflorescences of distinct plant species attracted spiders with different foraging strategies. Greco and Kevan (1994) demonstrated that even without any available prey, *Misumena vatia* (Clerck) was attracted to yellow color and to a specific plant species, and proposed that these spiders use vision to select microhabitats. In addition, Lou-da (1982) detected differences in the abundances of *Peucetia viridans* (Hentz) (Oxyopidae) on inflorescences of two *Haplopappus* species (Asteraceae), suggesting that either inflorescence morphology could influence prey availability, or inflorescence type could provide some unknown favorable characteristics for those spiders. Inflorescence dwelling spiders can represent an excellent system to clarify questions about which variables influence the distribution of this important arthropod group on the vegetation, because inflorescences have special microhabitat characteristics when compared to non-reproductive branches, potentially influencing the composition and abundance of spider prey and predators attracted to these patches.

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